

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4303

Roll No.

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B. Tech.
(SEMESTER-II) THEORY EXAMINATION, 2011-12
ENGINEERING MECHANICS

Time : 3 Hours]**[Total Marks : 100**

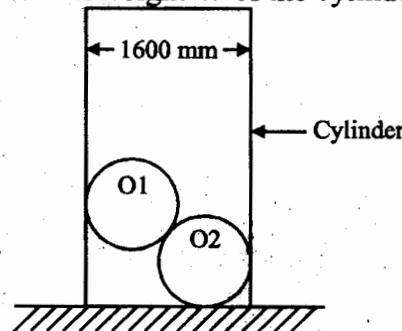
- Note :**
1. This paper is in three sections. Section A carries 20 marks, section B carries 30 marks and section C carries 50 marks.
 2. Attempt **all** questions. Marks are indicated against each question part.
 3. Assume missing, data if any.

SECTION – A

1. You are required to answer **all** the parts. **10 × 2 = 20**
 - (a) What is equilibrium ? State the necessary and sufficient conditions for a system of coplanar forces to be in equilibrium.
 - (b) State Varignon's theorem.
 - (c) What is the relationship between load, shear force and bending moment ? Define point of Contraflexure. In what types of beam this point occurs ?
 - (d) Define product moment of Intertia and polar moment of Intertia.
 - (e) Differentiate between centroid and center of gravity.
 - (f) Define tangential, normal and resultant acceleration of a particle.
 - (g) State the principle of conservation of momentum and give some of its particle applications.
 - (h) Define the term pure bending. Also write bending formula.
 - (i) Differentiate between torsional rigidity and torsional stiffness.
 - (j) Define rigid body. How it differs from elastic body ?

SECTION – B

2. Answer any **three** parts of the following : **3 × 10 = 30**
 - (a) A hollow right circular cylinder of radius 800 mm is open at both ends and rests on a smooth horizontal plane as shown in Fig. 1. Inside the cylinder there are two spheres having weights 1 kN and 3 kN and radius 400 mm and 600 mm respectively. The lower sphere also rests on the horizontal plane. Neglecting friction find the minimum weight W of the cylinder for which it will not tip over.

**Fig. 1**

- (b) Draw Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) for the beam shown in Fig. 2. Also locate the point of contraflexure.

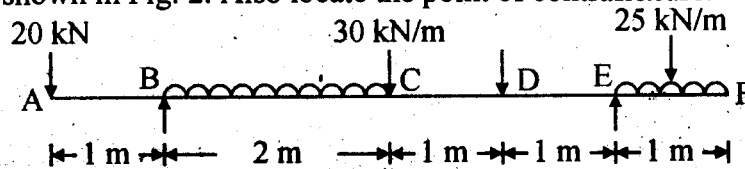


Fig. 2

- (c) Determine the moment of Inertia of the built-up section shown in Fig. 3 about its centroidal axis x-x and y-y.

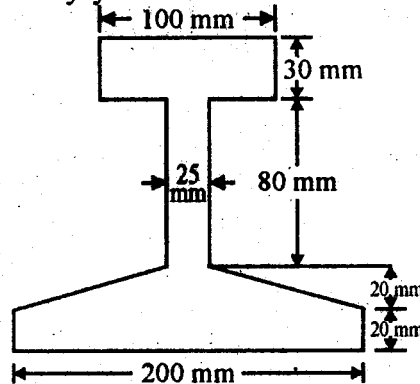


Fig. 3

- (d) Define the Torsion formula. Also indicate the various assumptions made in torsion theory.
- (e) A grining wheel is attached to the shaft of an elective motor of rated speed of 1500 rpm. When the power is switched on the unit attains the rated speed in 4 seconds and when power is switched off the unit comes to rest in 75 seconds, assuming uniformly accelerated motion determine the number of revolutions the unit turns to attain the rated speed and to come to rest.

SECTION - C

3. Answer any **two** parts of the following :

2 × 5 = 10

- (a) A torque of 300 Nm acts on the brake drum as shown in Fig. 4. If the brake bond is in contact with the brake drum through 250° and the coefficient of friction is 0.3. Determine the force P applied at the end of the brake lever for the position shown in Fig. 4.

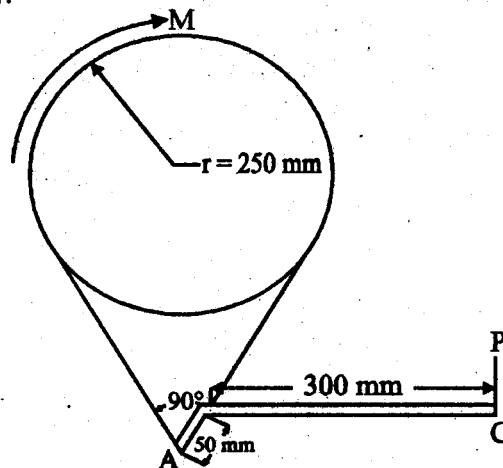


Fig. 4

- (b) Classify and explain the various force systems.
- (c) A uniform bar AB of length L and weight W lies in a vertical plane with its ends resting on two smooth inclined planes OA and OB and find angle θ for the equilibrium of bar as shown in Fig. 5.

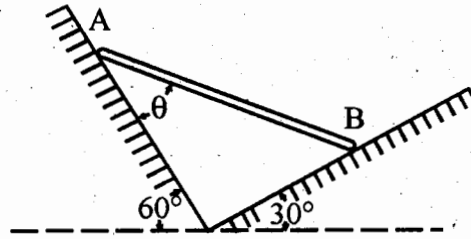


Fig. 5

4. Answer any **one** part of the following :

$1 \times 10 = 10$

- (a) The roof truss shown in Fig. 6 is supported at A and B and carries vertical loads at each of the upper chord points. Using the method of sections determine the forces in the member CE and FG of truss.

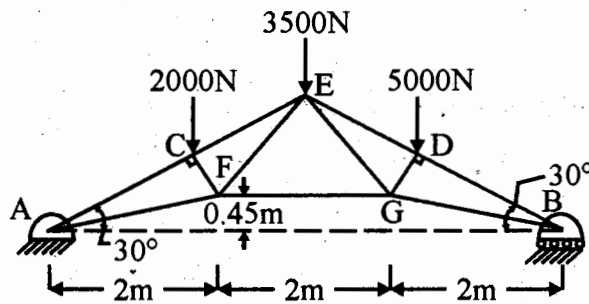


Fig. 6

- (b) Draw SFD and BMD for the following loaded beam also find the point of contraflexure as shown in Fig. 7.

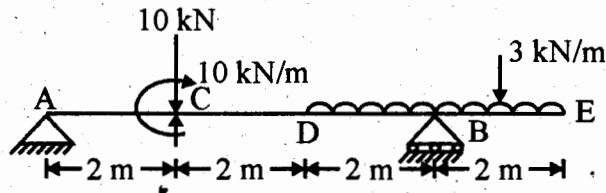


Fig. 7

5. Answer type **two** parts of the following :

$2 \times 5 = 10$

- (a) Write short note on Principal moment of Inertia and Mass moment of Inertia.
- (b) Determine the centroid of a sector of a circle of radius R and central angle 2α .
- (c) Determine the moment of Inertia of a solid sphere of radius R about its diametral axis.

6. Answer any **one** part of the following :

$1 \times 10 = 10$

- (a) A cylinder weighing 500 N is welded to a 1.0 m long uniform bar of 200 N as shown in Fig. 8. Determine the acceleration with which the assembly will rotate about point A, if released from rest in horizontal position determine the section at A at this instant.

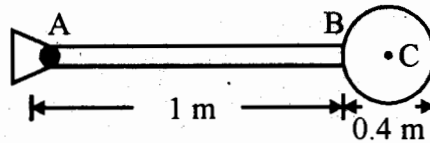


Fig. 8

- (b) A wheel of radius 1.0 m rolls freely with an angular velocity of 5 rad/sec and with an angular acceleration of 4 rad/sec², both clockwise as shown in Fig. 9 determine the velocity and acceleration of points B and D shown in figure.

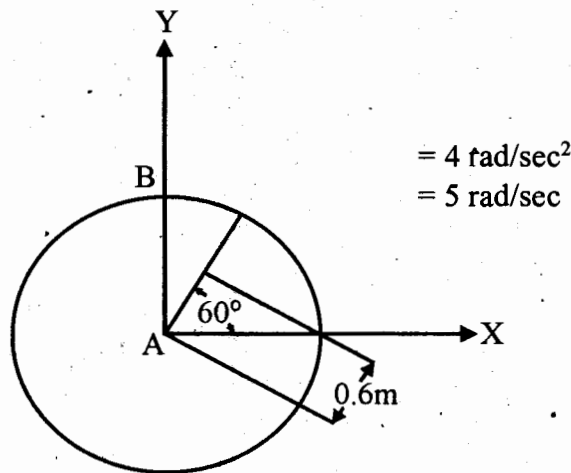


Fig. 9

7. Answer any **two** parts of the following :

$2 \times 5 = 10$

- (a) Differentiate between engineering stress and true stress. Also draw the stress-strain diagram for a ductile material showing all the points on it.
- (b) Determine the diameter of solid shaft which will transmit 450 kW at 300 rpm. The angle of twist must not exceed one degree per metre length and maximum torsional shear stress is to be limited to 40 N/mm². Assume $G = 80 \text{ kN/mm}^2$.
- (c) Prove that the ratio of depth to width to the strongest beam that can be cut from a circular log of diameter 'd' is $\sqrt{2}$.